Results of forest insect and disease surveys in the EASTERN REGION of Ontario, 1990

CARRIED OUT BY THE GREAT LAKES FORESTRY CENTRE IN COOPERATION WITH THE ONTARIO MINISTRY OF NATURAL RESOURCES

A. Keizer

Miscellaneous Report No. 107

Forestry Canada Forêts Canada

Canada

FORESTRY CANADA, ONTARIO REGION

Ontario Region is one of six regional establishments located across Canada and operated by Forestry Canada. The overall objective of Forestry Canada is to promote the preservation, enhancement and wise use of a healthy, attractive and bountiful forest resource and terrestrial environment for the economic and social benefit of all Canadians. Ontario Region pursues this objective by conducting two major programs: research and technical services and forestry development. Both programs address major problems affecting forest management and the forest environment primarily in Ontario, but because of the transprovincial nature of the forest resource, many elements of our research program are of national significance.

Ontario Region specializes in research in forest production, forest protection, forest environment and forest utilization. These programs deal directly with the issue of maintaining and enhancing the resource supply. Activities range from basic to applied and developmental research, and include a significant technology transfer component.

Major activities in forestry development include federal management responsibility for federal-provincial forest management agreements, participation in the National Forestry Statistics program and forest economics research.

Close working relationships are maintained with the Ontario Ministry of Natural Resources, the forest industry, educational institutions specializing in forestry and the biological sciences, and other forestry organizations within the province. Ontario Region is represented on the Ontario Forestry Council and the Ontario Forestry Research Committee, which have responsibility for coordinating forestry research in Ontario.

It is recognized that forested land must be managed in the best public interest, not only for the wood production essential to our economy, but also for the recreational purposes that are so important to our social well-being. This must be achieved in a manner that will maintain or improve the quality of the forest environment and preserve it for generations to come.

RESULTS OF FOREST INSECT AND DISEASE SURVEYS IN THE EASTERN REGION OF ONTARIO 1990

(FOREST DISTRICTS: NAPANEE, TWEED, CARLETON PLACE, and BROCKVILLE)

A. Keizer

FORESTRY CANADA

ONTARIO REGION

GREAT LAKES FORESTRY CENTRE

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SURVEY HIGHLIGHTS

This report details the results of surveys and estimates of insect, disease and abiotic damage to forests in the Eastern Region of Ontario during 1990.

Increasing numbers of the pine false webworm caused as high as 35% foliar damage to red pine plantations in the Brockville, Carleton Place and Napanee districts.

Cedar leafminer damage increased throughout the Region, covering more than 554,310 ha and inducing low levels of top- and whole-tree mortality in Rideau Township, Carleton Place District, and Augusta Township, Brockville District.

A new "pocket" of spruce budworm damage was discovered in Gloucester Township, Carleton Place District; defoliation averaged 28% over 2 ha of 12-m white spruce trees. Forecasts predict higher population levels in 1991 at this same plantation.

Population levels of the larch casebearer increased, as did subsequent damage. Estimates ranged from 8 to 85% foliar damage throughout the Region.

Fall webworm damage was easily recognized by an increased number of webs, occasionally covering 100% of primarily single roadside ash trees scattered throughout the Region.

A 91.5% reduction in the area of moderate-to-severe defoliation caused by the gypsy moth occurred this year; only 5,883 ha of scattered pockets of defoliation were recorded in the Brockville, Carleton Place, Napanee and Tweed districts. Egg-mass surveys performed by Forestry Canada, Ontario Region, staff revealed fewer areas with predictions of high population levels for 1991.

A 32.8% reduction in the area of forest tent caterpillar defoliation (330,307 ha) occurred as had been predicted last year, with reductions expected again in 1991.

Jack pine sawfly and maple trumpet skeletonizer populations increased at various locations through the Region.

Scleroderris canker surveys once again failed to detect the presence of this disease in the Region.

White pine blister rust evaluations at four plantations revealed branch and stem cankers on 5 to 9% of the trees.

Increased levels of hardwood anthracnose, causing premature leaf-drop and discoloration, were evident throughout the Region, particularly from July to September.

Hardwood dieback (see Frontispiece) was found in 12 areas of Tweed District, along with seven smaller areas of white birch dieback in Gloucester Township of Carleton Place District. The area within which dieback occurred totaled 4,686 ha, with the largest area of primarily single-tree oak mortality scattered over 4,240 ha of Kaladar and Kennebec townships of Tweed District. The remaining areas were generally smaller pockets of hilltop mortality.

Maple health surveys continued, with reassessments of plots established in woodlot, rural and urban situations. Current dieback estimates increased slightly for some of the urban and woodlot trees. Over all, most trees appeared relatively healthy. The annual assessments of the North American Maple Project plots and Acid Rain National Early Warning System plots, which included an intensive 5-year sampling, have both indicated slight changes in the overall status of forest health in Eastern Region.

A slight decline at one of two oak health plots in Carleton Place District may be attributable to past years of drought and insect defoliation. This particular plot is located on thin soils intermixed with exposed rock.

Of 36 samples analyzed for the presence of pear thrips on sugar maple, 10 positive samples have been recorded across the Region. Associated light foliar damage was observed on basswood and sugar maple in Hallowell Township, Napanee District.

Finally, the cooperation and generous assistance supplied by the Ontario Ministry of Natural Resources from each of five districts is very much appreciated by Forestry Canada staff.

A. Keizer

Frontispiece

Forest tent caterpillar

Ash dieback

Drought

White birch dieback

Gypsy moth

Cedar dieback

Hardwood dieback

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INSECTS

Major Insects

Pine False Webworm, *Acantholyda erythrocephala* (L.)

An increase in the numbers of larvae was evident this year in the Carleton Place, Brockville and Napanee districts, where total defoliation estimates ranged from light (<10%) to moderate (35%).

A 1-ha plantation of 2.6-m red pine (*Pinus resinosa* Ait.) was infested for the fourth consecutive year near Lanark County Road 22, Fitzroy Township, Carleton Place District. Webmasses averaged seven per tree on 90% of the trees, with an average of 20% defoliation. No additional branch or whole-tree mortality was noted. A high-value 5-ha clonal orchard of 0.4-m-high white pine (*P. strobus* L.), also in Carleton Place District, sustained <10% defoliation. This same area averaged two webs per tree on 39% of the trees. A smaller, 0.5-ha plantation of 1.0-m-tall red pine located along Highway 62 in Thurlow Township, Napanee District, sustained 35% defoliation, with an average of four webs per tree on 90% of the trees.

Lightly damaged (<10%) trees were also observed within the town of Kemptville on ornamental mugho pine (*Pinus mugho* Turra var. *mughus* Zenari) and near the town of East Oxford in Oxford on Rideau Township, both in Brockville District, where 20 of 25 (80%) 2-m hedgerow red pine trees averaged two webs per branch.

Cedar Leafminer complex, *Argyresthia aureoargentella* Brower, *A. canadensis* Free., *A. thuiella* (Pack.), *Coleotechnites thujaella* Kft.

Leaf mining and associated damage increased this season; combined with two previous years of physiological disorders, this has caused top and occasional whole-tree mortality of eastern white cedar (*Thuja occidentalis* L.) in the Brockville and Carleton Place districts (see the section on Cedar Decline). Aerial observations disclosed severe foliar browning over 16 townships in the central portion of the Region, as well as smaller areas of damage in the Tweed (Tudor, Madoc and Huntingdon townships) and Napanee (Percy, Cramahe and Brighton townships) districts, totaling 554,310 ha (Fig. 1.)

Defoliation estimates ranged from 25 to 80% at eight stands assessed throughout the Brockville and Carleton Place districts. Many of these stressed and defoliated trees renewed lost foliage over the summer. A second generation of defoliating larvae began feeding again in early August; they will spend the winter months inside hollowed needles on the host. This newer generation provides a second window for control of the infestation, usually in mid-August. Feeding is not as vigorous or complete as during the spring (April/May), which is still the most effective time for control.

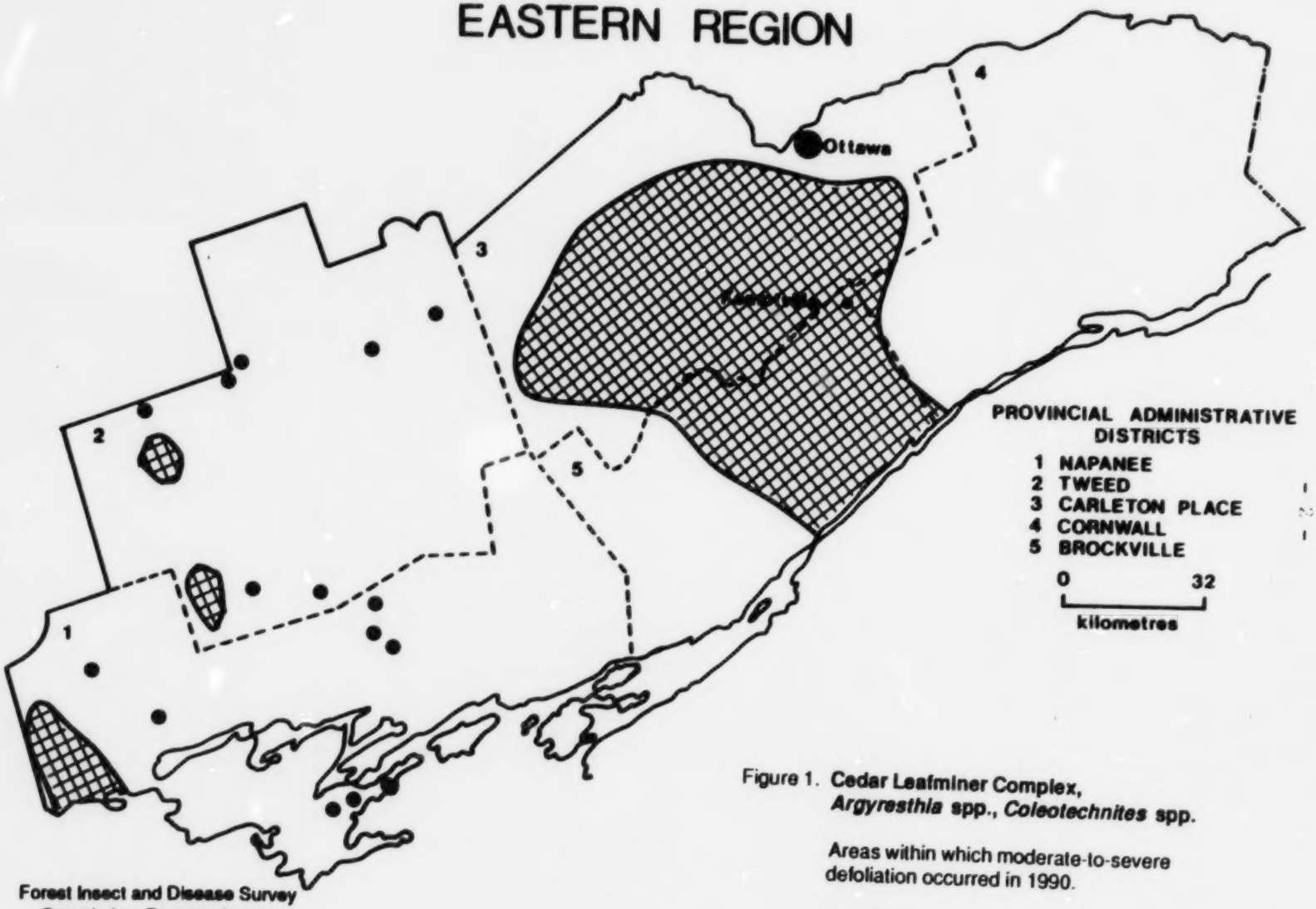

Figure 1. **Cedar Leafminer Complex, *Argyresthia* spp., *Coleotechnites* spp.**

Areas within which moderate-to-severe defoliation occurred in 1990.

or

Spruce Budworm, *Choristoneura fumiferana* (Clem.)

Provincial Situation

During 1990, a total of 6,783,261 ha of balsam fir (*Abies balsamea* [L.] Mill.) and spruce (*Picea* spp.) sustained moderate-to-severe defoliation, an increase of 543,625 ha from the 6,239,636 ha defoliated during 1989. This increase occurred primarily in the Northwestern and North Central regions, with new pockets of damage found in the Algonquin and Central regions (Fig. 2).

The biological insecticide *Bacillus thuringiensis* Berliner was applied over 49,627 ha of Crown land by the Ontario Ministry of Natural Resources (OMNR) in the Thunder Bay and Nipigon districts of North Central Region during 1990.

Eastern Region

A new pocket of light defoliation was recorded in Eastern Region on Davidson Road in Gloucester Twp, Carleton Place District. The 2-ha plantation of 12-m white spruce (*Picea glauca* [Moench] Voss) trees sustained an average of 28% current defoliation. Egg-mass samples used to predict future populations indicate a moderate-to-severe reinfestation will occur at this plantation in 1991. Elsewhere in the Region, light-trap and pheromone-trap catches have remained at low levels.

Larch Casebearer, *Coleophora laricella* Hbn.

Numbers of this introduced European insect have increased, with subsequent increased foliar damage to Japanese larch (*Larix leptolepis* [Sieb. & Zucc.] Gord.) and tamarack (*Larix laricina* [Du Roi] K. Koch) throughout the Region during 1990.

Only one generation of this insect occurs per year; however, damage in a single season results from larval feeding by two generations of the casebearer. Larvae spend the winter inside previously mined needles attached to host branches. In the spring, these larvae move to the flushing needles and feed for 3 to 4 weeks. This feeding is the most intensive and destroys the most host foliage. Pupation occurs within cases formed by webbing needles together, and adults emerge to deposit eggs on other host needles throughout most of the summer (May-August). These eggs soon hatch into a new generation of larvae that will feed before overwintering within a host tree.

Foliar damage ranged from 8 to 85% at several locations in the Brockville, Carleton Place and Cornwall districts. The two stands of tamarack most severely affected were detected from the air in South Plantagenet Township, Cornwall District, where a 1.5-ha stand of 7-m trees sustained 85% defoliation, and in Huntley Township, Carleton Place District, where a 0.5-ha area of 11-m trees sustained 80% defoliation. A stand of Japanese larch located off Lanark County Road 2 in Carleton Place District sustained an average of 23% foliar damage to 100% of the 8-m trees. European larch

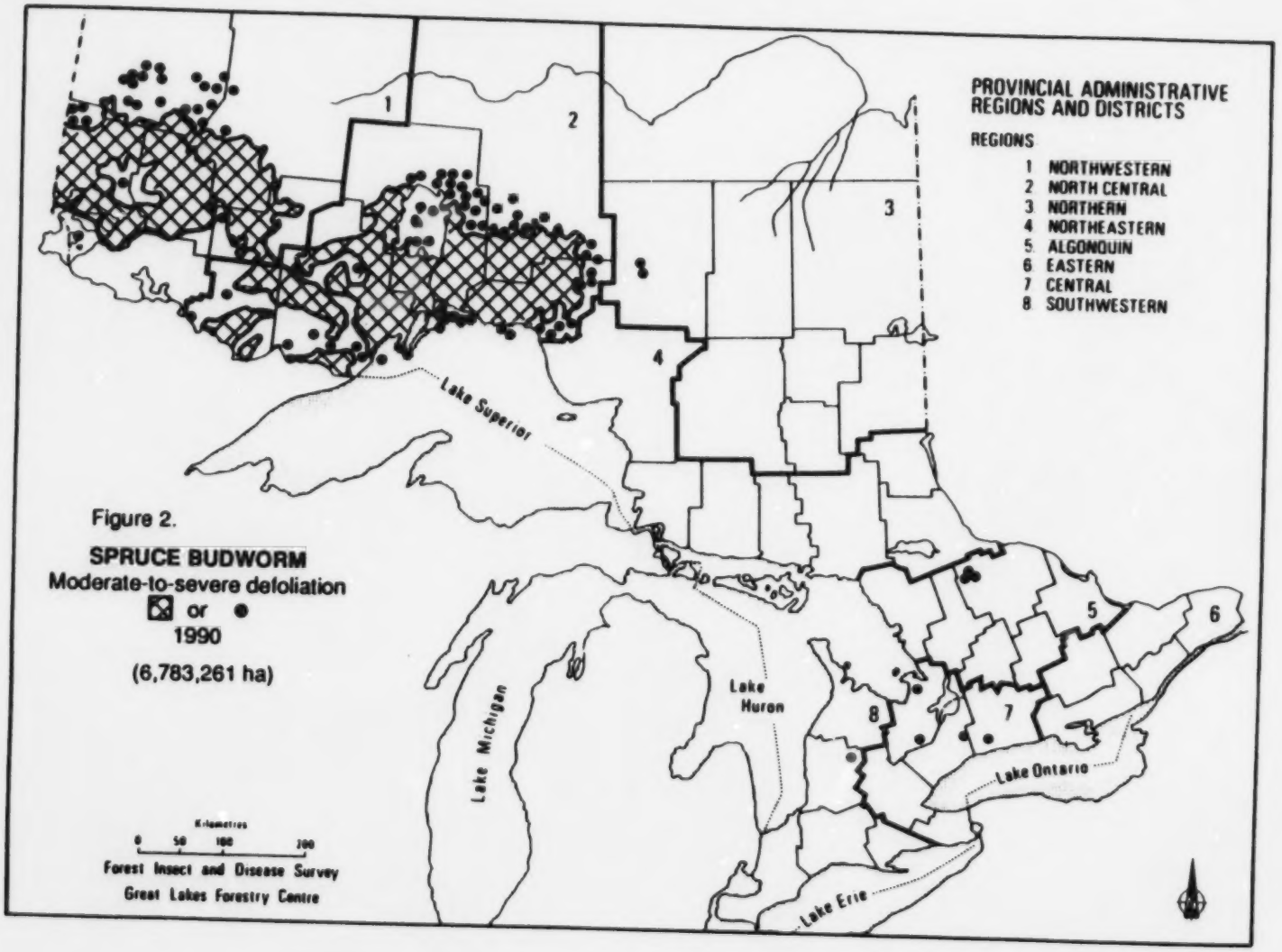
PROVINCIAL ADMINISTRATIVE REGIONS AND DISTRICTS
REGIONS
1 NORTHWESTERN
2 NORTH CENTRAL
3 NORTHERN
4 NORTHEASTERN
5 ALGONQUIN
6 EASTERN
7 CENTRAL
8 SOUTHWESTERN
Lake Superior
Lake Michigan
Lake Huron
Lake Ontario
Lake Erie
SPRUCE BUDWORM
Moderate-to-severe defoliation
or
1990
(6,783,261 ha)
Kilometres
0 50 100 200
Forest Insect and Disease Survey
Great Lakes Forestry Centre

Figure 2.

(*Larix decidua* Mill.) was found mixed with a stand of Japanese larch; there was an overall foliar damage level of 8% in 1 ha of 5-m trees. In this mixture, the European larch sustained minimal (<2%) foliar damage. At three other plantations of tamarack, foliar damage estimates ranged from 46 to 60% (Table 1).

Table 1. Surveys for the larch casebearer in seven plantations in the Eastern Region of Ontario in 1990 (evaluations based upon an examination of 150 trees).

Location (Twp)	Host[a]	Avg. ht. of trees (m)	Estimated trees per ha	Estimated area affected (ha)	Avg. defoliation per affected tree[b] (%)
Brockville District					
Edwardsburgh	EL, JL	5	1,060	1	8
Oxford on Rideau	T	8	500	0.5	60
Carleton Place District					
Montague	JL	8	1,000	1	23
Osgoode	T	3	600	1	46
Gloucester	T	5	800	1	52
Huntley	T	11	600	0.5	80
Cornwall District					
South Plantagenet	T	7	1,200	1.5	85

[a] EL = European larch, JL = Japanese larch, T = tamarack
[b] 100% of the trees were affected.

Fall Webworm, *Hyphantria cunea* (Drury)

Increased numbers of webs were observed throughout the Region on single trees and small groups of hardwoods, with ash (*Fraxinus* spp.) being the most common host this year. Total defoliation was not uncommon on host trees of all sizes, especially in lowland and open-field situations. A 2-ha area of scattered white ash (*Fraxinus americana* L.) averaging 8 m tall in Mountain Township, Cornwall District, contained as many as 37 webs per tree. Similar levels were observed within the boundaries of Charleston Lake Provincial Park along the lake shore, where primarily single ash trees were totally covered with larval webbing. Various numbers of webs were also observed along the St. Lawrence Parkway in Brockville District and along Highway 401 in the Cornwall, Brockville and Napanee districts, with defoliation estimates ranging from 10 to 100%.

Gypsy Moth, *Lymantria dispar* (L.)

The regional total of moderate-to-severe defoliation declined from 68,981 ha in 1989 to 5,883 ha of mainly scattered pockets in 1990 (a 91.5% reduction) (Fig. 3).

This area represents only 7.6% of the 77,648 ha of moderate-to-severe defoliation present in Ontario during 1990. The Algonquin and Central regions of Ontario sustained the majority of hardwood defoliation (87% of 77,648 ha, or 67,859 ha in all).

The majority of the defoliation in Eastern Region occurred in Napanee District, with 4,086 ha of scattered pockets of damage ranging from 10 to 190 ha in size (Tables 2 and 3). These areas were located primarily in Bedford, Loughborough, Portland, Storington, Kingston and Pittsburgh townships, Frontenac County; Adolphustown and Ernestown townships, Prince Edward County; Thurlow and Sidney townships, Hastings County; and Seymour and Percy townships, Northumberland County (Figs. 3 and 4).

Table 2. Gross area of moderate-to-severe hardwood defoliation by the gypsy moth in the Eastern Region of Ontario during 1989 and 1990.

District	Year		Change	
	1989	1990	%	Area (ha)
Napanee	15,001	4,086	-72.8	-10,915
Tweed	39,096	1,259	-96.8	-37,837
Brockville	12,250	395	-96.8	-11,855
Carleton Place	2,634	143	-94.6	-2,491
Cornwall	0	0	0	0
	68,981	5,883		

Table 3. Gross area of moderate-to-severe hardwood defoliation by the gypsy moth during 1989 and 1990, by county.

County	Area (ha)	
	1989	1990
Frontenac	11,625	3,234
Lennox and Addington	905	12,660
Hastings	22,262	806
Northumberland	8,231	607
Leeds and Grenville	12,250	395
Lanark	2,590	143
Prince Edward	340	74
Ottawa-Carleton	44	0

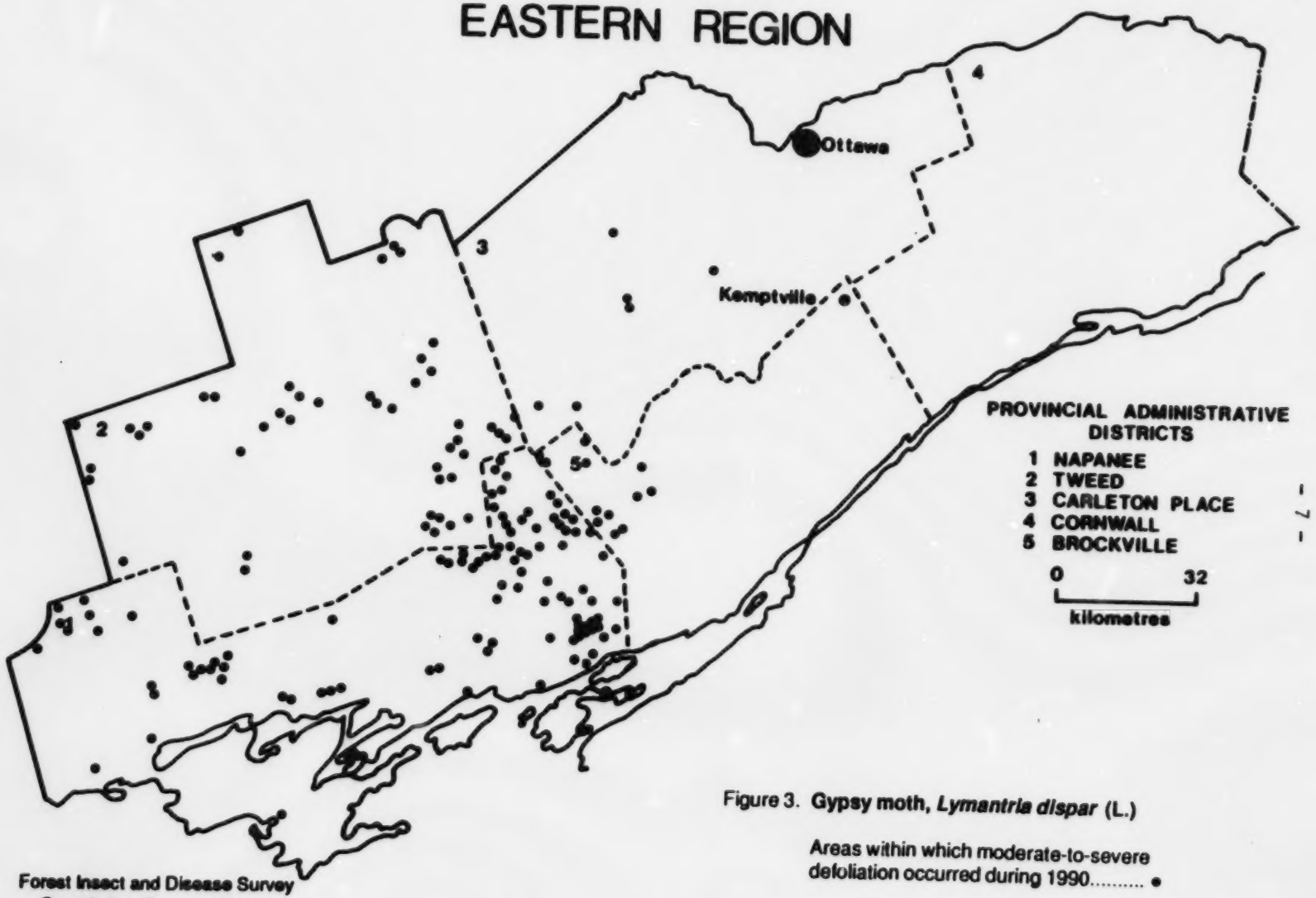

Figure 3. Gypsy moth, *Lymantria dispar* (L.)

Areas within which moderate-to-severe defoliation occurred during 1990..... •

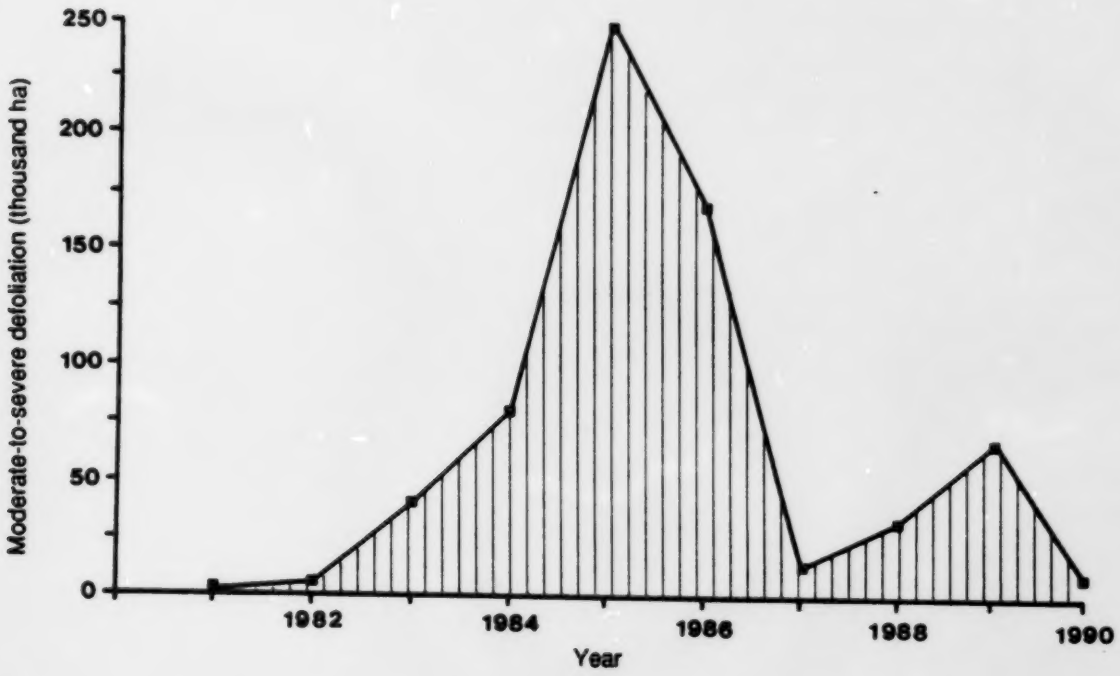

Figure 4. Area of moderate-to-severe defoliation by the gypsy moth (*Lymantria dispar* [L.]) in the Eastern Region of Ontario from 1981 to 1990.

Tweed District contained 21% of the regional defoliation, with 1,259 ha of small pockets ranging from 13 to 75 ha in size. These areas were primarily concentrated in Hinchinbrooke, Olden and Oso townships, Frontenac County; in Anglesea Township, Lennox and Addington County; and in Tudor and Lake Townships, Hastings County. The most northerly areas of defoliation in the Region were in Ashley, Miller and North Canonto townships, Tweed District.

Brockville District forests were relatively free of extensive defoliation this year, with only 395 ha affected in 15 pockets of moderate-to-severe defoliation. These areas were found in North Crosby, South Crosby and Bastard townships, Leeds and Grenville County, and ranged from 13 to 65 ha in size.

Carleton Place District contained 143 ha of gypsy moth-infested forests scattered among seven areas ranging from 18 to 24 ha in size. These were recorded in South Sherbrooke, Bathurst, Drummond, Beckwith and Ramsay townships, Lanark County.

Egg-mass surveys performed by Forestry Canada, Ontario Region, (FCOR) staff during the months of August and September indicate that rein-

festations may occur at moderate-to-severe levels at the following locations: the Skunk Lake area, Darling Township, Carleton Place District; the Westport area of North Crosby Township and the Charleston Lake-Hill Island-Gananoque area, Brockville District; in Frontenac Provincial Park (Salmon Lake area), Napanee District; and the Crowe Lake area of Marmora Township, Tweed District.

The gypsy moth burlap larval trapping and pheromone trapping programs have been virtually discontinued in southern Ontario as the primary means of detection. A smaller experimental program is continuing in some areas, primarily to test various pheromone traps and concentrations. In Eastern Region, 13 parks were again trapped and the results are presented in Table 4.

The average number of adults captured in pheromone traps placed in 13 parks (two per park) during 1990 was 24.2. The burlap traps (10 per location) revealed slightly higher catches than in 1989, with the largest numbers reported from Sharbot Lake, Fitzroy and Lake-on-the-Mountain Provincial Parks.

The gypsy moth fungus *Entomophaga maimaga* Humber, Shimazu & Soper was recovered for the first time in Ontario from dead larvae sampled near Sandbanks Provincial Park, Napanee District. This entomopathogenic fungus has reportedly caused extensive epizootics in outbreak populations of gypsy moth in the northeastern United States. Surveys will be initiated next spring in an effort to isolate additional pathogens.

Host Impact

Twenty-six randomly selected plots were established throughout the Tweed and Napanee districts during 1982 soon after gypsy moth populations became a problem in 1981. These plots consist of 387 trees (13 different species), which are assessed for defoliation, dieback, mortality and growth increment. A partial summary of information from unpublished studies by D.B. Roden (FCOR) is given in Table 5. Defoliation estimates for 1988 are unavailable because of technical discrepancies, and mortality in 1988 has been included with the 1989 figures. Increased mortality is evident during both 1989 and 1990. This increase is a probable reflection of the drought that occurred in these years and severe defoliation caused by both the forest tent caterpillar and gypsy moth since 1988.

Forest Tent Caterpillar, *Malacosoma disstria* Hbn.

The overall area of moderate-to-severe defoliation has decreased in 1990, an indication that the natural controlling factors (i.e., parasites, diseases, climate, etc.) have again caused a declining trend, typical of this insect's infestation cycle. Over all, there was a 32.8% reduction in the area of moderate-to-severe hardwood defoliation, from 438,919 ha in 1989 to 330,307 ha in 1990 (Fig. 5).

Table 4. Results of gypsy moth burlap and pheromone trapping and defoliation estimates at 13 parks in the Eastern Region of Ontario during 1990.

Location (Provincial Park)	Burlap traps (10 per location) Total no. larvae 1989	1990	Pheromone traps (2 per location)[a] No. of male moths captured 1989	1990	Average defoliation estimates Hosts	%	Egg-mass estimate[b]
Brockville District							
Charleston lake	314	719	16	67	sM, rO, tA, wB	10	7
Carleton Place District							
Fitzroy	-	3,157	14	53	rO, sM, tA, siM	5	15
Murphy's Point	269	723	17	1,254[d]	rO, tA, wB, sM	15[c]	14
Rideau River	27	17	36	44	siM, tA, wB	2	3
Silver Lake	760	264	26	36	rO, sM, tA, wB	10[c]	11
Cornwall District							
Carillon	0	0	36	43	wB, sM	3	2
Jessup's Falls Cons. Area	1,069	612	45	36	rO, tA, wB	3	5
Napanee District							
Frontenac	422	584	21	1,451[d]	rO, tA, wB	35[c]	23
Lake-on-the-Mountain	378	1,655	38	48	sM, siM	10	1
Presquile	0	257	31	71	rO, sM	5	2
Sandbanks	125	30	30	90	rO, wB, tA, sM	5	3
Tweed District							
Bon Echo	314	310	24	44	rO, tA, sM	20	10
Sharbot Lake	-	3,018	34	1,381[d]	rO, sM, tA, wB	30[c]	6

[a] USDA Deltoid stick type
[b] average based upon the 5-minute-walk method
[c] includes forest tent caterpillar
[d] MultiPher-2 type of trap with G. Grant lures; three per location; catches not included with averaged Deltoid trap results

Table 5. Defoliation and mortality in gypsy moth impact plots established in 1982 and monitored from 1982 to 1990 in the Eastern Region of Ontario.

Tree species	Total no. of trees	No. dead trees when plot established	No. of dead trees								Avg. defoliation								Total no. dead 1982-1990	% total dead
			1982	1983	1984	1985	1986	1987	1989[b]	1990	1982	1983	1984	1985	1986	1987	1989	1990		
Red oak (*Quercus alba* L.)	195	10	0	0	3	1	2	5	26	15	30	25	12	75	25	27	98	39	62	32
White oak (*Q. alba* L.)	69	0	0	0	0	1	1	0	2	3	41	34	18	57	17	22	97	21	7	10
Red maple (*Acer rubrum* L.)	73	2	0	1	2	1	2	2	6	3	5	7	5	38	1	7	21	10	17	23
Sugar maple (*A. saccharum* Marsh.)	8	0	0	0	0	0	0	0	0	0	4	1	0	3	1	5	10	5	0	0
White ash (*Fraxinus americana* L.)	10	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	30	13	0	0
White birch (*Betula papyrifera* Marsh.)	9	0	0	0	1	0	0	3	0	1	1	3	35	33	1	4	15	5	4	44
Ironwood (*Ostrya virginiana* [Mill.] K. Koch)	13	0	0	0	0	0	0	0	1	0	15	4	3	1	1	1	17	6	1	8
Others[a]	10	0	0	0	1	1	0	1	1	0	7	9	16	39	1	3	18	5	4	40

[a] trembling aspen (*Populus tremuloides* Michx.), Eastern white pine (*Pinus strobus* L.), white elm (*Ulmus americana* L.), butternut (*Juglans cinerea* L.), shagbark hickory (*Carya ovata* [Mill.] K. Koch), black cherry (*Prunus serotina* Ehrh.)

[b] includes 1988 mortality

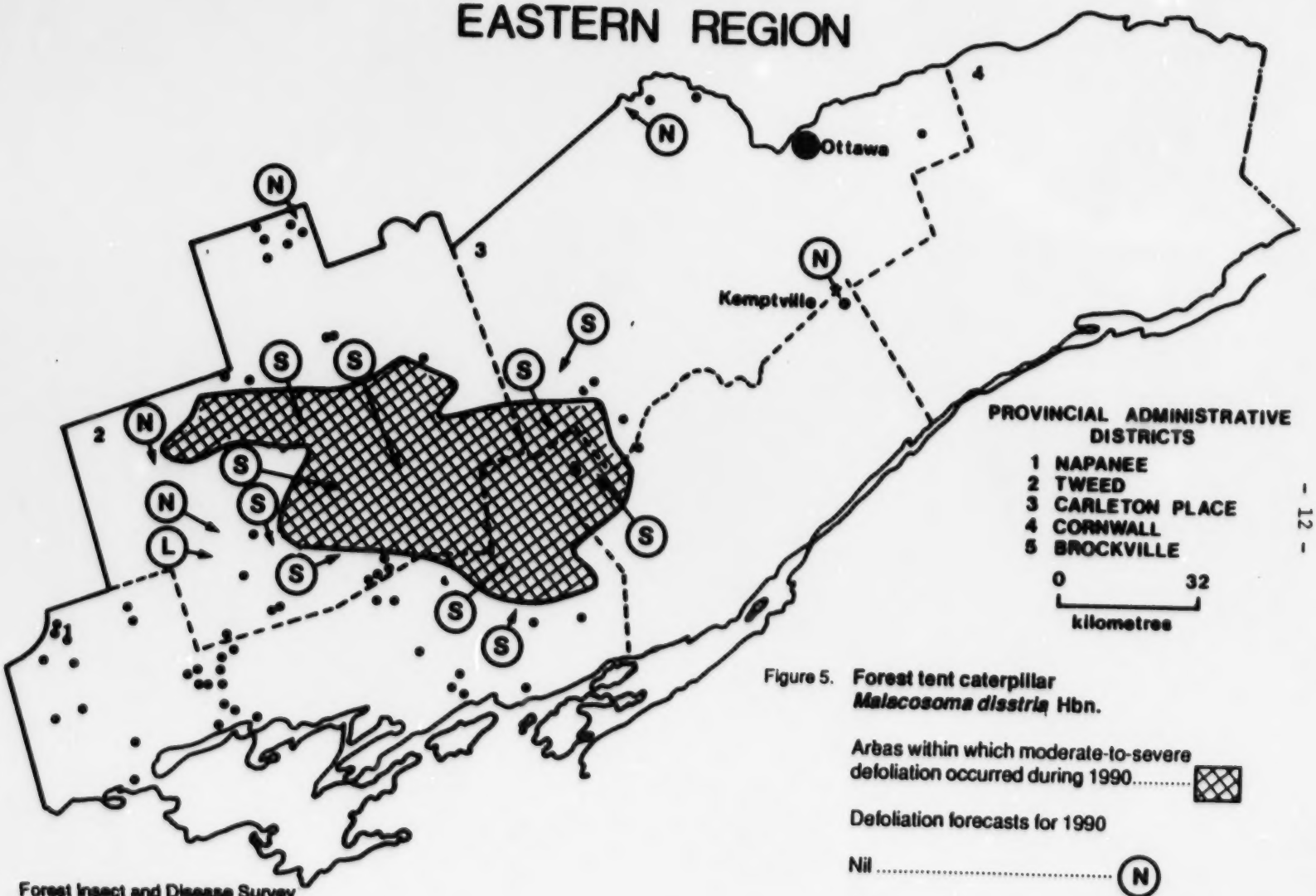

Figure 5. **Forest tent caterpillar *Malacosoma disstria* Hbn.**

Areas within which moderate-to-severe defoliation occurred during 1990.....

Defoliation forecasts for 1990

Nil ..... N

Light L

Moderate ..... M

Severe ..... S

Tweed District contained the largest area of insect-damaged hardwoods, with 215,441 ha (65% of the regional total) (Table 6). An eastward movement of this infestation has isolated a large area of the same outbreak that has extended southeastward from the Central and Algonquin regions since 1988[1]. Some portions of Tweed District have been defoliated for three (Tudor, Grimsthorpe, Anglesea, Barrie, Elzevir and Kaladar townships) and four (Kaladar and Elzevir townships) consecutive years. Tudor, Grimsthorpe, Anglesea, Barrie, Clarendon, Kaladar, Kennebec, Olden, Oso, Sheffield and Hinchinbrooke townships sustained moderate-to-severe levels of defoliation and were a major part of the large "pocket" present in the Region. Additional smaller "pockets" were located in Denbigh, Abinger and Hungerford townships.

Table 6. Gross areas of moderate-to-severe defoliation caused by the forest tent caterpillar in the Eastern Region of Ontario in 1989 and 1990.

District	Area of moderate-to-severe defoliation (ha)	
	1989	1990
Tweed	345,104	215,441
Napanee	81,248	78,479
Brockville	720	22,020
Carleton Place	11,847	14,367
Cornwall	0	0
Total	438,919	330,307

The area of moderate-to-severe defoliation in Napanee District decreased by 5% (2,769 ha), from 81,248 ha in 1989 to 78,479 ha in 1990. This area shifted from the western portion of the district to newer infestations that occurred in the northeastern portion of the district. This area includes Portland, Loughborough, Bedford and Storington townships. Smaller defoliated stands were also recorded in Seymour, Sidney, Thurlow, Camden, Ernestown and Kingston townships.

Additional new areas of defoliation appeared over 22,020 ha in Brockville District this year. This easternmost edge of the main pocket of hardwood defoliation crossed into North Crosby and South Crosby townships.

The area of hardwood defoliation in Carleton Place District increased slightly, from 11,847 ha in 1989 to the present 14,367 ha. Major shifts from the areas damaged in 1989 were evident, with reductions throughout Pakenham,

[1] Keizer, A. 1990. Results of forest insect and disease surveys in the Eastern Region of Ontario, 1989. For. Can., Ont. Reg., Sault Ste. Marie, Ont. Misc. Rep. 93.

Darling and Ramsay townships. South Sherbrooke and North Burgess townships contained an extension of the main pocket this year and smaller affected stands were also observed in Cumberland, Fitzroy, Torbolton and Bathurst townships.

Forest tent caterpillar population levels for 1991 are forecasted using egg-band counts taken in the fall; the results are presented in Table 7. This year's estimates for 1991 indicate a reinfestation of approximately the same area, with slight border fluctuations to the east in the Carleton Place and Napanee districts (Fig. 5). A continuing decline in the total area affected will probably occur over the next few years as a result of the natural control factors mentioned above.

Table 7. Forest tent caterpillar egg-band samples collected from trembling aspen and red oak in four districts of the Eastern Region of Ontario 1990, with infestation forecasts for 1991.

District (Township)	Host	Avg. tree DBH (cm)	No. of trees sampled	Avg. no. of egg bands per tree	Infestation forecast for 1991
Brockville District					
North Crosby	tA	21	1	36	Severe
Oxford on Rideau	tA	10	3	0	Nil
Carleton Place District					
Bathurst	tA	17	1	32	Severe
Fitzroy	tA	14	3	0	Nil
South Sherbrooke	tA	19	3	17	Severe
Napanee District					
Loughborough - Frontenac Prov. Pk	rO	15	3	16	Severe
Loughborough - Sydenham	rO	20	2	14	Severe
Sheffield	tA	9	3	6	Severe
Tweed District					
Anglesea	tA	15	3	17	Severe
Denbigh	tA	12	3	0	Nil
Hinchinbrooke	rO	21	2	14	Severe
Hungerford	tA	10	3	8	Severe
Huntingdon	tA	14	3	1	Light
Kaladar	tA	11	3	14	Severe
Madoc	tA	13	3	0	Nil
Tudor	tA	13	3	0	Nil

Jack Pine Sawfly, *Neodiprion pratti paradoxicus* Ross

Increasing numbers of defoliated jack pine (*Pinus banksiana* Lamb.) and Scots pine (*Pinus sylvestris* L.) trees have prompted numerous control inquiries by urban and rural landowners. Most instances concerned individual open-grown or ornamental trees as well as hedgerows and plantations. Visual estimates of defoliation for these situations ranged from 2 to 90%. Evaluations of five jack pine plantations revealed an average defoliation ranging from 20 to 60% (Table 8).

Many private landowners initiated control by following specific application instructions supplied with available contact insecticides.

Table 8. Jack pine sawfly evaluations in five jack pine plantations in the Eastern Region of Ontario in 1990 (evaluations based upon an examination of 150 trees).

Location (Twp)	Avg. ht. of trees (m)	Estimated trees per ha	Estimated area affected (ha)	Trees affected (%)	Avg. defoliation per affected tree (%)
Brockville District					
Augusta	1.5	1,000	1.5	60	35
Elizabethtown	1	1,250	0.5	98	60
South Gower	5	1,500	1	82	60
Carleton Place District					
Goulbourn	2.5	200	1	50	20
Rideau	2.5	600	2.5	60	30

Minor Insects

Maple Trumpet Skeletonizer, *Epinotia aceriella* (Clem.)

Since 1987, moderate-to-severe damage by this insect has been present on maple regeneration and the lower crowns of mature sugar maple (*Acer saccharum* Marsh.) over approximately 25 ha of Presquile Provincial Park. Located in Hallowell Township, Napanee District, this area has sustained the highest recorded levels of defoliated crowns and regeneration to date, with an average of 65% crown defoliation over 75% of the 21-m trees. Forest-floor sugar maple regeneration sustained even higher levels of defoliation, averaging 80% over all.

Defoliation estimated at <25% was observed at Carillon Provincial Park, Hawkesbury Township, Cornwall District, on lower crowns of scattered roadside sugar maples. A 20-ha woodlot of 25-m sugar maple near the town of Athens in Rear of Yonge and Escott Township, Brockville District, also sustained light damage to 10% of the lower crowns and regeneration.

Table 9. Other forest insects.

Insect	Host(s)	Remarks
Cameraria aceriella (Clem.) Maple leafblotch miner	sM	Regenerating maple 1 to 2 m tall averaged two mines/leaf throughout Carillon Provincial Park, Cornwall District, and Presquile Provincial Park, Napanee District. A 2-ha area of regeneration in Lot 1, Conc. VI, Pakenham Twp, Carleton Place District, averaged 50% leafmining damage.
Choristoneura p. pinus Free. Jack pine budworm, and *Zelleria haimbachi* Bsk. Pine needle sheathminer	jP	A 4-ha plantation of 2.5-m trees trees sustained 80% foliar damage to 45% of the trees near Lennox and Addington County Road 4 and Hwy 401, Ernestown Twp, Napanee District. For the third consecutive year, *Z. haimbachi* has been the principle defoliator. *Choristoneura p. pinus* was present for the first season at trace levels.
Cinara strobi (Fitch) White pine aphid	wP	A single 2-m roadside tree on Ottawa-Carleton County Road 8 near South Manotick, Gloucester Twp, Carleton Place District, contained one colony per branchlet.
Coleophora comptoniella McD. Lesser birch casebearer	wB	This casebearer was commonly found in large numbers across the Region; average defoliation was <10%.
Conotrachelus juglandis LeC. Butternut curculio	Bu	Mining of terminal shoots averaged 60% on mature trees scattered along Conc. IV, Bedford Twp, Napanee District.

(cont'd)

Table 9. Other forest insects (cont'd).

Insect	Host(s)	Remarks
Elaphidionoides parallelus (Newm.) Hickory twig pruner	rO, wO, biHi, burO, sbHi	Single semimature and mature trees were occasionally observed throughout the region with various numbers (1 to 20) of pruned branches within the crown. Large numbers of pruned branches were observed on a single, mature bur oak (approximately 100 branches were observed on the ground) in Charleston Lake Provincial Park, Brockville District. A red oak stand near Joe's Lake, Lavant Twp, Carleton Place District, sustained an average of 10 pruned branches per tree over 1 ha.
Fenusa ulmi Sund. Elm leafminer	wE	Single pole-sized trees scattered scattered through Fitzroy Provincial Park, Carleton Place District, sustained 75 to 100% defoliation.
Gnophothrips sp. Thrips	ScP	A Christmas tree plantation sustained severe foliar browning to the upper 50% of crowns on 8% of the 1.8-m trees at Lot 17, Conc. VI, Edwardsburgh Twp, Brockville District.
Leucoma salicis (L.) Satin moth	eCo	A grove of nine 25-m trees at Lot 6, Conc. VIII, Elizabethtown Twp, Brockville District, sustained 90% defoliation.
Neodiprion abietis complex Balsam fir sawfly	bF	Six 4-m trees averaged 10% upper-crown defoliation at Silver Lake Provincial Park and approximately 20 8-m trees sustained 50% upper-crown defoliation along Ottawa-Carleton County Road 5 west of Fitzroy, Carleton Place District.

(cont'd)

Table 9. Other forest insects (cont'd).

Insect	Host(s)	Remarks
Neodiprion sertifer (Geoff.) European pine sawfly	rP, ScP	A 1-ha plantation of 5-m red pine trees averaged three colonies per tree and 2% defoliation on 6% of the trees along Hwy 16 in South Gower Twp, Brockville District. Single colonies on single Scots pine trees of various sizes were evident throughout the Region, with light (<10%) damage.
Paraclemensia acerifoliella (Fitch) Maple leafcutter	sM	Light (<10%) foliar damage was observed on single trees of all sizes at Carillon Prov. Park, Cornwall District; Sandbanks Prov. Park, Napanee District; a 5-ha, mature woodlot on Prince Edward County Road 12, Hallowell Twp, Napanee District; and in Murphy's Point Prov. Park, Carleton Place District.
Pikonema alaskensis (Roh.) Yellowheaded spruce sawfly	wS	Four 1-m high trees were 20% defoliated in a plantation in Lot 17, Conc. VI, Edwardsburgh Twp, Brockville District.
Pineus strobi (Htg.) Pine bark adelgid	wP	A 1.0-ha plantation of 10-m trees trees in Fitzroy Prov. Park, Carleton Place District, contained six trees with this insect, covering 90% of the main stems. The Taylor Lake clonal seed orchard in Lanark Twp, Carleton Place District, contained this insect on 65% of the 0.4-m trees in a 5-ha area. Control was initiated by OMNR staff.
Pristiphora geniculata (Htg.) Mountain-ash sawfly	aMo	Single trees of all sizes sustained defoliation ranging from 10 to 40% at Presquile, Sandbanks, Bon Echo and Rideau River provincial parks.

(cont'd)

Table 9. Other forest insects (concl.)

Insect	Host(s)	Remarks
Psilocorsis sp. A leaftier	rO	Severe skeletonizing of leaves was common this season; the highest levels were observed in Presquile Prov. Park, where 50% of the trees averaged 20% defoliation.
Rhynchaenus rufipes LeC. Willow flea weevil and *Plagiodera versicolora* (Laich.) Imported willow leaf beetle	Willow	Severe foliar browning induced by these leaf-feeding beetles was most apparent near Collins Bay at Kingston, at the mouth of the Trent River at Trenton, and in Silver Lake and Sharbot Lake provincial parks.
Scolioneura betuleti Klug. Birch edgeminer	European birch	A new distribution record was recorded in Ontario with collections made from two 5-m trees on Cataraqui Street in Kingston, with 80% of the foliage affected.
Sericothrips tiliae Hood Basswood thrips	Ba	These insects caused considerable leaf distortion and puckering to 80% of the foliage through most of the host on affected trees in Sharbot Lake Prov. Park.
Tetralopha asperatella (Clem.) Maple webworm	sM	An average of one web per branch caused 10% defoliation to 50% of the trees along the Frontenac Prov. Park road and similar damage in a 5-ha, mature woodlot near Athens, Brockville District; the webworm was commonly observed throughout the Region.

TREE DISEASES

Major Diseases

Scleroderris Canker, *Ascocalyx abietina* (Lagerb.) Schläpfer-Bernhard

Aerial and ground surveys once again failed to detect the presence of this disease of pine and spruce in the Region during 1990. Particular attention was paid to plantations in northern Tweed District adjacent to active infections by the European race in Mayo Township, Bancroft District. Sixteen plantations were surveyed from the ground (500 trees evaluated per site) throughout the Region. Ground surveys will be continued in 1991.

White Pine Blister Rust, *Cronartium ribicola* J.C. Fischer

Moderate infection levels of this disease were evident in four eastern white pine plantations surveyed in the Region. Stem infections were found on 4% of the 2.8-m trees in a 5-ha plantation in Lot 2, Concession 1, Elizabethtown Township, Brockville District. Over all, infections were found on 9% of these trees. Another 3-ha plantation of 2.2-m trees in Gloucester Township near Leitrim, Carleton Place District, also sustained 4% main-stem infections of the 2.2-m trees. An additional 2% of the trees over 3 ha contained branch infections. A 4-ha plantation of 1.8-m trees in Lot 24, Concession II, in Edwardsburgh Township, Brockville District, contained branch cankers on 5% of the trees.

Anthracnose, *Aureobasidium apocryptum* (Ell. & Ev.) Hermanides-Nijhof, *Apiognomonia errabunda* (Rob.) Höhnel, *Discula campestris* (Pass.) v. Arx, *Gnomonia caryae* Wolf var. *caryea*
and Leaf Spot Diseases, *Septoria populicola* Peck, *Microstroma juglandis* (Bereng.) Sacc., *Mycosphaerella effigurata* (Schwein.) House

Aureobasidium apocryptum, *A. errabunda* and *D. campestris* caused widespread foliar browning to sugar maple throughout the Region. The largest area of moderate-to-severe foliar damage was observed in Sandbanks Provincial Park, where a 2-ha sugar bush of 20-m trees averaged 30% browning to 100% of the trees. Hedgerows of mature trees also averaged 30% foliar damage on three urban streets within the town of Campbellford. Similar damage was evident in the town of Brockville and on single trees scattered throughout Silver Lake Provincial Park.

Septoria populicola appears each year, usually in mid-to-late summer, causing foliage of balsam poplar (*Populus balsamifera* L.) to blacken, turn yellow and drop prematurely. Earlier infections in 1990 caused concern to many landowners beginning in mid-August. Discolored single roadside and ornamental trees were common throughout the Region.

Mycosphaerella effigurata also caused severe browning and premature leaf drop to single and small groups of white ash throughout the Region. The largest area of damage occurred over a 2-ha area of 5-m lowland trees in Sandbanks Provincial Park, Napanee District, where 90% of the trees sustained an average of 60% foliar browning. Similar damage was also observed over a 1-ha area in Carillon Provincial Park, Cornwall District, a 1-ha area in Charleston Lake Provincial Park, Carleton Place District, and scattered individuals in the Mill Pond Conservation Area, Brockville District.

Microstroma juglandis and *G. caryae* var. *caryae* caused 100% foliar browning to a 0.5-ha stand of shagbark hickory (*Carya ovata* [Mill.] K. Koch) on Frontenac County Road 19, Loughborough Twp, Napanee District.

Table 10. Other forest diseases.

Organism	Host(s)	Remarks
Coleosporium asterum (Dietel) Sydow Pine needle rust	jP	A 1-ha plantation of 2-m trees in South Gower Twp, Brockville District, averaged 10% lower foliar damage on 2% of trees.
Cryptococcus fagisuga Linding. Beech scale and *Nectria galligena* Bresad. Nectria canker	Be	Presquile Prov. Park had an average of 2% of stems affected for the third consecutive year by this insect. An additional sample of *N. galligena* was recovered from a third tree in the area. A small reinfestation by this insect (5% of stems affected) occurred for the fourth consecutive year at the Gananoque Golf Course.
Melanconis juglandis (Ell. & Ev.) Groves Walnut canker and *Sirococcus clavigignenti-juglandacearum* Nair, Kostichka & Kuhtz Butternut canker	Bu	Single trees were sampled for butternut canker on Leeds and Grenville County Road 6, Elizabethtown Township, Brockville District, and in Bedford Twp, Frontenac County Road 8, Napanee District. Each contained walnut cankers on 5 to 25% of their branches.
Sphaeropsis sapinea (Fr.) (Dyko) & B. Sutton Diplodia tip blight	muP, ScP, AP	Five 10-m mugho pine trees in Presquile Prov. Pk sustained 50% branch mortality. Scots pine and Austrian pine (approximately 20 trees) along River Road in the City of Ottawa averaged 25% branch mortality.

ABIOTIC DAMAGE

Drought and Hardwood Dieback

Extreme weather conditions and successive attacks from major defoliating insects have produced areas with extensive hardwood mortality and dieback, primarily in Tweed District. Fluctuating water-table levels induced by the drought conditions experienced over the past few years have also caused considerable white birch (*Betula papyrifera* Marsh.) dieback and mortality in Gloucester Township, Carleton Place District.

Twelve separate areas have been identified from the air as containing pockets of mortality and dieback or damaged single trees (4,686 ha) in Tweed District. All 12 areas were on thin-soiled ridges and hilltops (Fig. 6). The largest area, covering an estimated 4,240 ha in Kaladar and Kennebec Townships, Tweed District, contains primarily scattered single-tree mortality (approximately 8% mortality of red oak). This area has also been repeatedly defoliated by gypsy moth infestations over the past decade. The second largest area, located along the northern shore of Kennebec Lake, Kennebec Township, Tweed District, contained pockets of red oak, maple (*Acer* spp.), aspen (*Populus* spp.) and birch (*Betula* spp.) mortality as well as declining individual trees over approximately 276 ha.

Two single hillside pockets of hardwood mortality were also observed near the town of Campbellford (7.8 ha) in Seymour Township, Napanee District, and near Lingham Lake (32 ha) in Grimsthorpe Township, Tweed District.

Eight other areas of mortality and dieback occurred in Lake and Tudor townships, Tweed District, ranging from 1 to 53 ha in size. A single impact plot consisting of 25 trees was established in an accessible area of mortality north of the town of Millbridge in Tudor Township, Tweed District. A similar plot was established adjacent to the impact plot for control purposes (Table 11). The major species in the impact plot was red oak, which averaged 20.4 cm in DBH and 11.3 m tall; mortality was 94% (16 of 17 trees). The control plot, located some 10 m down the ridge from the impact plot and within the same stand, contained no mortality. Current dieback affected an average of 78% of the trees in Class 1 (6-20%) and 22% in Class 0 (0-5%). Cumulative dieback estimates were even higher: all 25 trees had sustained between 6 and 60% dieback (classes 1-3).

Small stands of white birch near Leitrim in Gloucester Township, Carleton Place District, have succumbed to the effects of fluctuating water tables over the past few years (Fig. 6). Eleven areas totaling 64.4 ha and ranging in size from 1 to 11.5 ha were aerially mapped during 1990. Specific surveys will be initiated during the 1991 season to obtain detailed data.

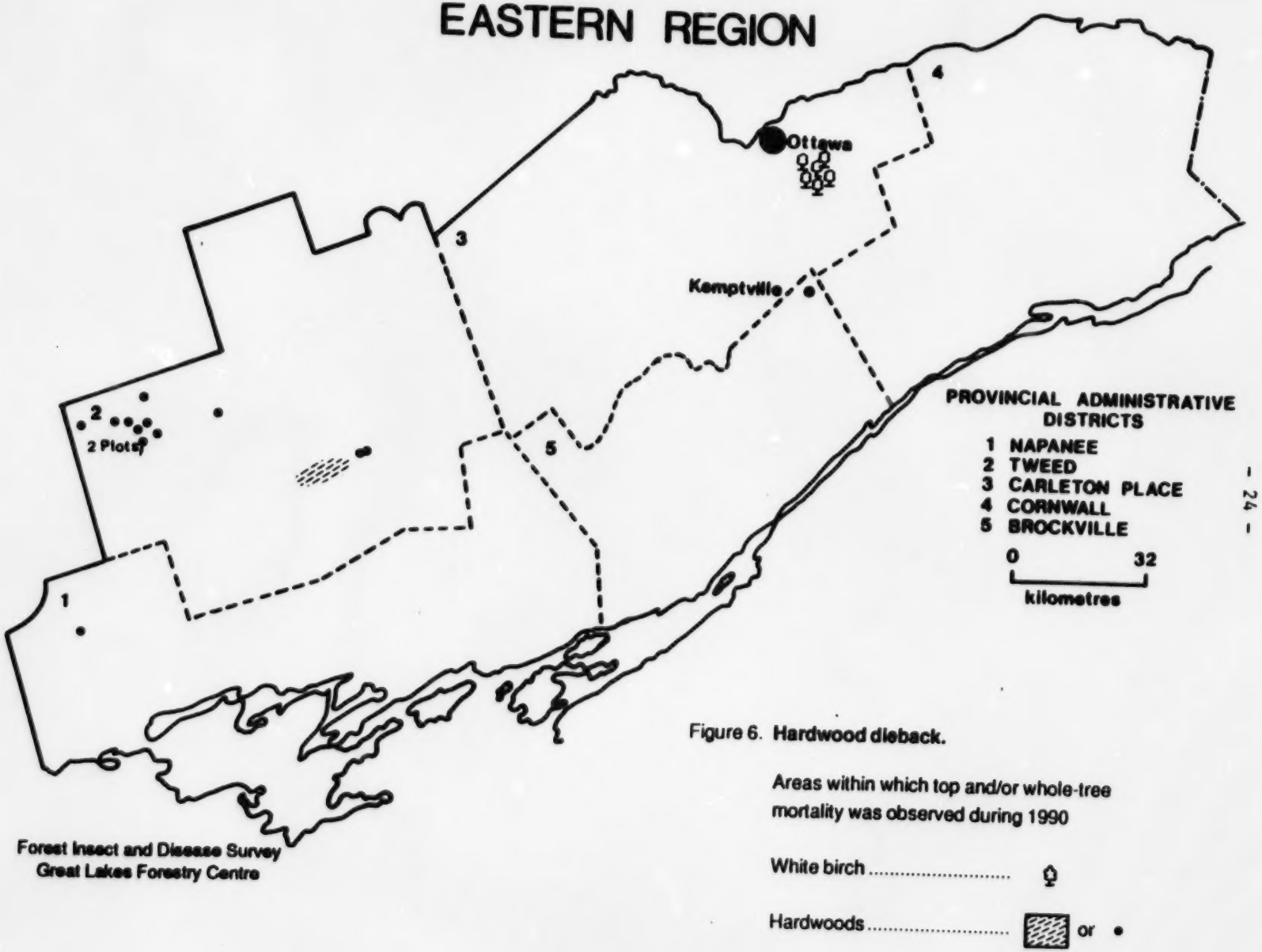

Figure 6. **Hardwood dieback.**

Areas within which top and/or whole-tree mortality was observed during 1990

Table 11. Data from two plots established within an area of hardwood mortality (Impact Plot 1) and an and an adjacent area (Control Plot 1) during 1990 in Tudor Township, Tweed District (plots consist of 25 trees).

	Tree species	No. of trees	Avg. DBH (m)	Avg. ht. (m)	Basal area (m^2/ha)	No. of trees with crown dieback, by dieback class											
						Current						Cumulative					
						0	1	2	3	4	5	0	1	2	3	4	5
Impact Plot 1																	
	rO	17	20.4	11.3	21.7	0	1	0	0	0	16	0	1	0	0	0	16
	wP	6	14.6	6.7	5.0	6	0	0	0	0	0	6	0	0	0	0	0
	sM	1	9.5	7.0	0	0	1	0	0	0	0	0	1	0	0	0	0
	rM	1	8.0	6.9	0	1	0	0	0	0	0	1	0	0	0	0	0
Control Plot 1																	
	rO	18	23.0	16.8	16.7	4	14	0	0	0	0	0	10	7	1	0	0
	rM	4	11.3	12.5	3.3	3	1	0	0	0	0	3	0	1	0	0	0
	He	2	12.2	5.5	3.8	2	0	0	0	0	0	2	0	0	0	0	0
	wP	1	46.8	18.0	0	0	1	0	0	0	0	0	1	0	0	0	0

[a] Dieback classification: 0 = 0-5%, 1 = 6-20%, 2 = 21-40%, 3 = 41-60%, 4 = >61%, 5 = dead

Cedar Dieback

Over the past 3 years, eastern white cedar stands throughout the Region have survived growth and foliar losses caused by drought, winter browning, stress-related seed crops, and high population levels of leafmining insects. The toll has now become most evident in two areas of two districts, in which low levels of top and whole-tree mortality are now present. In Carleton Place District along Ottawa-Carleton County Road 3, Rideau Township, a 150-tree evaluation revealed 18% top mortality and 2% whole-tree mortality over approximately 50 ha of 6-m trees. Approximately 20-ha of 8-m-tall roadside trees sustained 6% top mortality off Leeds and Grenville County Road 21 near Bellamy, Augusta Township, Brockville District. Numerous roadside trees sustained top and whole-tree mortality throughout the Carleton Place and Brockville districts near the above two locations.

Ash Dieback

Although light levels of single-tree dieback have been evident in the past from various causes, the more recent drought and this year's late-spring frost have apparently induced higher levels of dieback and low levels of mortality. Roadside and hedgerow situations appeared to be the most susceptible with the highest levels observed in Napanee District: 100% of the trees in a 5-ha white ash stand in Camden Township were affected, 20% severely, and 2% mortality occurred; in Thurlow Township, 90% of the trees in a 2-ha stand were affected, 10% severely, and 2% mortality occurred.

FOREST HEALTH

Acid Rain National Early Warning System (ARNEWS)

A rising concern for Canadian forests began in the early 1980s when alarming levels of tree decline, supposedly as a result of air pollutants, were being reported from other parts of the world. In 1984, ARNEWS plots were established nationally by Forestry Canada to detect early signs of damage. Three of these plots are located in Eastern Region: in an eastern white pine stand in Hungerford Township, Tweed District; in a white spruce stand in Gloucester Township, Carleton Place District; and in a sugar maple stand in Rear of Yonge and Escott Township, Brockville District. To date, no symptoms of acidification-related damage have been detected. The 5-year intensive sampling occurred in 1990 and lab results are pending.

Maple Health Surveys

Woodlot

Ten 25-tree sugar maple plots established during 1987 in woodlots have been reassessed for crown dieback and presence of defects. The 1990 assessments have revealed a decline in the condition of current growth from dieback in the 0-5% range (Class 0) in 1989 to dieback in the 6-20% range in

1990 (Class 1) (Table 12). Cumulative crown dieback also increased slightly, with 7% of the trees with more than 21% (between classes 2 and 4). Blowdown has killed two additional trees at the Rear of Leeds and Lansdowne Township plot, Brockville District. Estimates of insect damage were generally light (<10% average defoliation) at eight of 10 plots, with the principle defoliators being the forest tent caterpillar, the gypsy moth and the maple webworm (*Tetralopha* spp.), in order of importance. The maple trumpet skeletonizer has created an average of 29% foliar damage at both the entrance and staff-house plots in the Presquile Provincial Park plot, Brighton Township, Napanee District.

Urban and Rural

Five urban (i.e., city parks, streets, shade trees, etc.) and five rural (i.e., roadsides, windrows, driveways, right-of-ways, etc.) sugar maple plots, each with 25 trees, were reassessed for the second year in 1990 (Table 13).

The urban plots (Fig. 7) have appeared relatively healthy in both years, with more than 90% of the trees in classes 0 or 1 (<20% branch mortality). Cumulative branch dieback estimates were slightly higher this year, with 23.2% of the trees having more than 40% branch mortality (classes 3 and 4) versus 11.2% of the trees in 1989. The remaining 76.8% were assessed in classes 0 or 1.

The rural plots contained slightly higher numbers of trees with more than 20% current branch dieback (classes 2 to 5); this was true for more than 10% of the rural trees and less than 7% of the urban trees. Cumulative branch damage worsened slightly, with 72% of the trees with <20% in 1989 versus 78.4% of the trees in classes 0 and 1 in 1990.

When overall estimates are calculated for all 250 trees, a slight yearly increase is observed in the proportion of trees with 6 to 20% (class 1) current branch dieback: 40% in 1989 and 53.6% in 1990. Cumulative estimates also show a slightly degraded overall condition, with fewer trees in classes 0 and 1 (<20%) and higher estimates in 1990 within the 21-40% class (Class 2). New mortality occurred in one plot in which five trees had been felled for unknown reasons.

Insects and diseases generally affected <10% of the foliage over all, with the exception of 12% of the trees in Seymour Township, Napanee District, which sustained an average of 38% foliar damage from *Discula campestris* (Pass.) v. Arx. Principle defoliators were the forest tent caterpillar, the gypsy moth and the maple webworm.

Table 12. Annual summary of maple health data from 10 plots established in woodlots/stands during 1987 to monitor sugar maple health in the Eastern Region of Ontario (data based on the examination of 25 host trees per location).

Location (Twp)	Avg. DBH (cm)	Avg. ht. (m)	Estimated stand area (ha)	Year	No. of trees with crown dieback[a]											
					Current						Cumulative					
					0	1	2	3	4	Trees dead	0	1	2	3	4	Trees dead
Brockville District																
Oxford on Rideau	35.6	24	15	1987	21	4	0	0	0	0	12	13	0	0	0	0
				1988	25	0	0	0	0	0	9	16	0	0	0	0
				1989	25	0	0	0	0	0	5	20	0	0	0	0
				1990	21	4	0	0	0	0	2	23	0	0	0	0
Rear of Leeds and Lansdowne	66.4	28	2	1987	21	4	0	0	0	0	16	8	1	0	0	0
				1988	18	7	0	0	0	0	12	12	1	0	0	0
				1989	20	2	0	0	0	3[b]	0	20	2	0	0	3[b]
				1990	17	3	0	0	0	5[b]	2	18	0	0	0	5[b]
Rear of Yonge and Escott	33.6	21	30	1987	23	2	0	0	0	0	18	7	0	0	0	0
				1988	25	0	0	0	0	0	14	11	0	0	0	0
				1989	23	2	0	0	0	0	4	21	0	0	0	0
				1990	20	5	0	0	0	0	9	13	0	3	0	0
Carleton Place District																
Nepean	37.1	20	4	1987	23	2	0	0	0	0	23	2	0	0	0	0
				1988	22	3	0	0	0	1	20	4	1	0	0	1
				1989	23	2	0	0	0	1	8	16	0	0	0	1
				1990	13	11	0	0	0	1	1	23	0	0	0	1

(cont'd)

Table 12. Annual summary of maple health data from 10 plots established in woodlots/stands during 1987 to monitor sugar maple health in the Eastern Region of Ontario (data based on the examination of 25 host trees per location) (cont'd).

Location (Twp)	Avg. DBH (cm)	Avg. ht. (m)	Estimated stand area (ha)	Year	No. of trees with crown dieback[a]											
					Current						Cumulative					
					0	1	2	3	4	Trees dead	0	1	2	3	4	Trees dead
Carleton Place District (concl.)																
Lavant	37.6	22	20	1987	19	6	0	0	0	0	16	8	1	0	0	0
				1988	16	9	0	0	0	0	12	13	0	0	0	0
				1989	25	0	0	0	0	0	0	23	2	0	0	0
				1990	17	8	0	0	0	0	1	22	2	0	0	0
Pakenham	50.5	25	15	1987	22	3	0	0	0	0	12	11	2	0	0	0
				1988	20	5	0	0	0	0	4	19	2	0	0	0
				1989	21	4	0	0	0	0	1	22	2	0	0	0
				1990	5	19	1	0	0	0	0	18	6	1	0	0
Napanee District																
Brighton, Staff House	53.9	23.2	1	1987	23	2	0	0	0	0	14	11	0	0	0	0
				1988	23	2	0	0	0	0	10	14	1	0	0	0
				1989	23	2	0	0	0	0	5	20	0	0	0	0
				1990	7	17	0	0	0	1	5	18	0	0	0	1
Brighton, Campsite	45.2	24.2	1	1987	24	1	0	0	0	0	20	4	1	0	0	0
				1988	21	4	0	0	0	0	3	22	0	0	0	0
				1989	25	0	0	0	0	0	3	22	0	0	0	0
				1990	15	10	0	0	0	0	3	22	0	0	0	0

(cont'd)

Table 12. Annual summary of maple health data from 10 plots established in woodlots/stands during 1987 to monitor sugar maple health in the Eastern Region of Ontario (data based on the examination of 25 host trees per location) (concl.).

Location (Twp)	Avg. DBH (cm)	Avg. ht. (m)	Estimated stand area (ha)	Year	No. of trees with crown dieback[a]											
					Current						Cumulative					
					0	1	2	3	4	Trees dead	0	1	2	3	4	Trees dead
Napanee District (concl.)																
Brighton, Entrance	54.2	22.5	2	1987	25	0	0	0	0	0	23	2	0	0	0	0
				1988	21	4	0	0	0	0	12	13	0	0	0	0
				1989	19	6	0	0	0	0	3	22	0	0	0	0
				1990	15	9	0	0	0	1	6	16	2	0	0	1
Cramahe	32.3	21.9	2	1987	25	0	0	0	0	0	24	1	0	0	0	0
				1988	25	0	0	0	0	0	14	11	0	0	0	0
				1989	25	0	0	0	0	0	12	13	0	0	0	0
				1990	17	8	0	0	0	0	7	17	1	0	0	0
% of total trees (n=250)				1987	90	10	0	0	0	0	71	27	2	0	0	0
				1988	85	14	0	0	0	1	43	54	0	0	0	1
				1989	91	7	0	0	0	2	16	80	2	0	0	2
				1990	59	38	1	0	0	2	15	76	4	2	1	2

[a] Dieback classification: 0 = 0-5%, 1 = 6-20%, 2 = 21-40%, 3 = 41-60%, 4 = >61%

[b] Blowdown

Table 13. Maple health data from 10 plots established in rural and 10 in urban situations during 1989 in the in the Eastern Region of Ontario (data based on the examination of 25 sugar maple trees per location) (cont'd).

Location (Twp)	Plot type	Avg. DBH (cm)	Avg. ht. (m)	Year	No. of trees with crown dieback[a]											
					Current						Cumulative					
					0	1	2	3	4	Trees dead	0	1	2	3	4	Trees dead
Brockville District																
Elizabethtown	Urban	64	23	1989	17	8	0	0	0	0	6	19	0	0	0	0
				1990	13	12	0	0	0	0	4	18	3	0	0	0
Front of Leeds and Lansdowne	Urban	59	24	1989	11	13	1	0	0	0	3	19	3	0	0	0
				1990	12	12	1	0	0	0	7	12	6	0	0	0
Oxford on Rideau	Urban	55	19	1989	19	4	2	0	0	0	6	15	3	0	1	0
				1990	11	14	0	0	0	0	3	17	5	0	0	0
Carleton Place District																
North Elmsley	Urban	68	22	1989	17	8	0	0	0	0	1	21	3	0	0	0
				1990	13	11	1	0	0	0	10	13	2	0	0	0
Napanee District																
Seymour	Urban	68	21	1989	9	14	2	0	0	0	1	20	4	0	0	0
				1990	0	19	1	0	0	5[c]	0	12	7	1	0	5[c]
Average		63	22													
% of trees (n=125)				1989	58.4	37.6	4.0	0.0	0.0	0.0	13.6	75.2	10.4	0	0.8	0.0
				1990	39.2	54.4	2.4	0.0	0.0	4.0	19.2	57.6	18.4	0.8	0.0	4.0

(cont'd)

Table 13. Maple health data from 10 plots established in rural and 10 in urban situations during 1989 in the in the Eastern Region of Ontario (data based on the examination of 25 sugar maple trees per location) (cont'd).

Location (Twp)	Plot type	Avg. DBH (cm)	Avg. ht. (m)	Year	No. of trees with crown dieback[a]											
					Current						Cumulative					
					0	1	2	3	4	Trees dead	0	1	2	3	4	Trees dead
Brockville District																
Edwardsburgh[b]	Rural	47	21	1989[b]	-	-	-	-	-	-	-	-	-	-	-	-
				1990	15	10	0	0	0	0	7	14	4	0	0	0
Napanee District																
Hallowell	Rural	59	26	1989	4	17	4	0	0	0	1	14	10	0	0	0
				1990	9	12	4	0	0	0	1	15	8	1	0	0
Hillier	Rural	67	19	1989	6	13	5	1	0	0	3	11	7	2	2	0
				1990	5	15	2	1	2	0	1	18	2	0	4	0
Kingston	Rural	53	23	1989	14	10	1	0	0	0	11	13	1	0	0	0
				1990	10	13	2	0	0	0	6	17	2	0	0	0
Loughborough	Rural	70	22	1989	13	9	3	0	0	0	1	18	5	1	0	0
				1990	7	16	2	0	0	0	0	19	5	1	0	0
Average		59	22													
% of trees (n=125)				1989	37.0	49.0	13.0	1.0	0.0	0.0	16.0	56.0	23.0	3.0	2.0	0.0
				1990	36.8	52.8	8.0	0.8	1.6	0.0	12.0	66.4	16.8	1.6	3.2	0.0

(cont'd)

Table 13. Maple health data from 10 plots established in rural and 10 in urban situations during 1989 in the Eastern Region of Ontario (data based on the examination of 25 sugar maple trees per location) (concl.).

Location (Twp)	Plot type	Avg. DBH (cm)	Avg. ht. (m)	Year	No. of trees with crown dieback[a]											
					Current						Cumulative					
					0	1	2	3	4	Trees dead	0	1	2	3	4	Trees dead
% of total trees (n=250)	Rural and Urban			1989	52.4	39.6	7.6	0.4	0.0	0.0	18.0	66.0	14.0	1.0	1.0	0.0
				1990	38.0	53.6	5.2	0.4	0.8	2.0	15.6	62.0	17.6	1.2	1.6	2.0

[a] Dieback classification: 0 = 0-5%, 2 = 21-40%, 3 = 41-60%, 4 = >61%

[b] Established in 1990

[c] trees felled

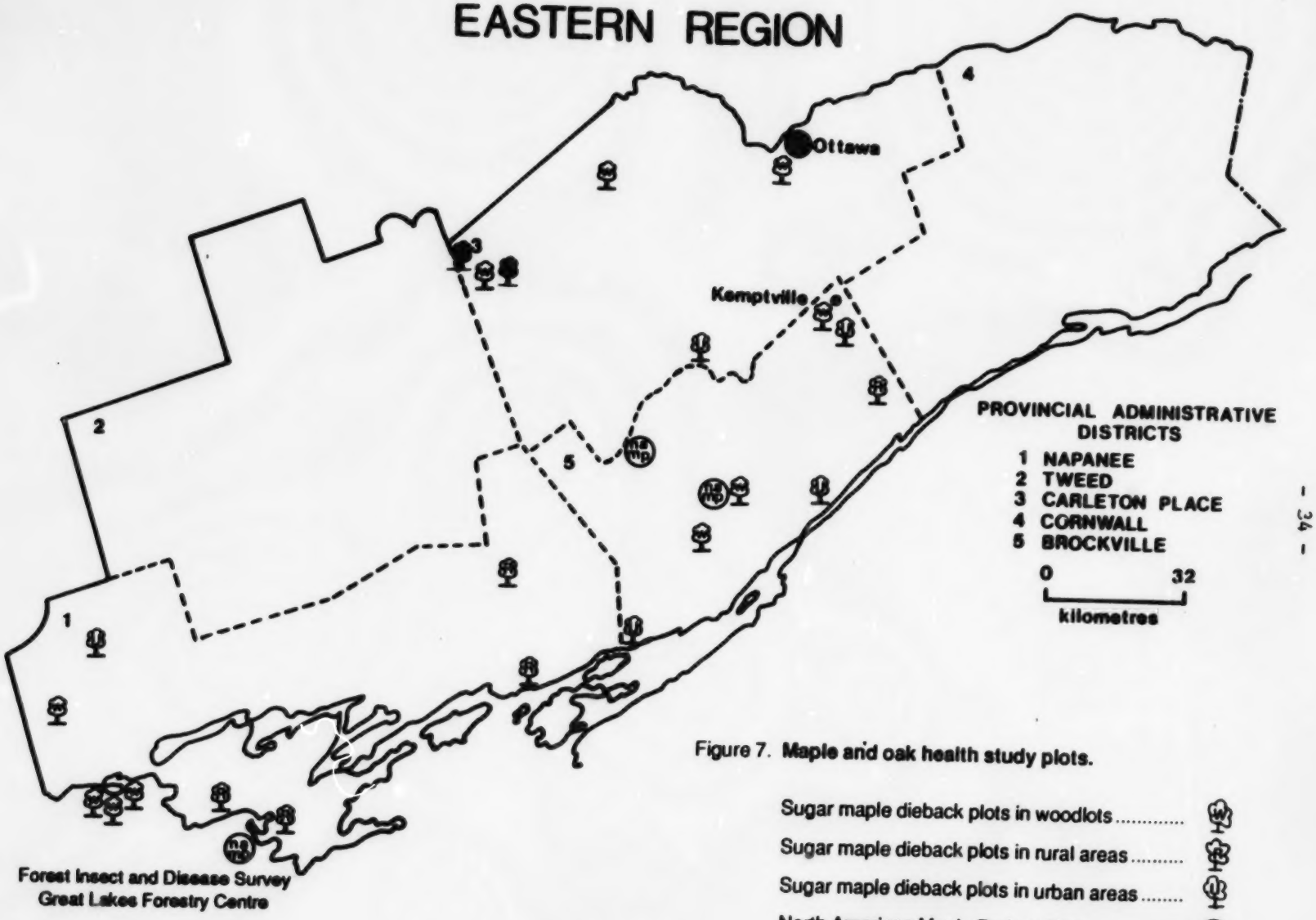

Figure 7. **Maple and oak health study plots.**

Sugar maple dieback plots in woodlots .....

Sugar maple dieback plots in rural areas .....

Sugar maple dieback plots in urban areas .....

North American Maple Project Plots .....

Red oak dieback plots .....

North American Maple Project (NAMP)

Numerous plots have been established and assessed annually since 1988 in four Canadian provinces and seven American states. The primary objectives of this project are to: (1) verify areas of maple dieback, if any; (2) monitor the rate of deterioration or recovery of trees; and (3) determine if changes in tree condition relates to levels of atmospheric pollution.

Three plots were established in the Napanee and Brockville districts of Eastern Region (Table 14). These plots contained a total of 132 sugar maple trees, of which more than 90% contained less than 15% dieback. Some dieback within a stand is considered normal. Yearly fluctuations in dieback have remained minimal. Statistical analyses of differences between managed sugar bush plots and undisturbed woodlot plots are not practical with only three plots. Further analysis of overall data is being done annually and will be made available in a separate report.

Oak Health Surveys

Of the two plots (100 trees per plot) assessed annually since 1984, branch dieback estimates have revealed a slightly degraded stand condition at Lavant Township plot 1, in Carleton Place District (Fig. 7). This plot occurs on thin soils that lie between sloping areas of exposed shield, and the trees appear to have survived the past few seasons of drought and gypsy moth infestations rather well. Increased current branch mortality occurred on 76% of the trees with a class 1 rating (6-20% branch mortality), compared with 58% during 1989 (Table 15). Cumulative branch dieback also increased slightly, with 38% of the trees rated in class 2 (21-40%) versus 26% in 1989. Insect damage averaged <10%, with principle defoliators, in order of importance, being the gypsy moth and the hickory twig pruner.

The second plot is located near Flower Station on a side-slope terrace approximately 8 km south of plot 1. Current and cumulative branch dieback estimates have remained relatively unchanged since 1989, with 82% of the trees in classes 1 and 2 (<20%) and 75% of the cumulative mortality in class 1 (6-20%).

Mortality estimates have shown a 2% annual increase over the past two years.

Table 14. Crown conditions of sugar maple assessed at three North American Maple Project plots in the Eastern Region of Ontario since 1988.

Location (Twp)	Year	Avg. DBH (cm)	No. of trees examined	Total dead crown (%)						Trees dead	No. of trees blown down or felled
				0	1-5	6-15	16-25	26-35	36-100		
				- - - - - Number of trees - - - - -							
Brockville District											
South Burgess[a]	1988	38.4	42	0	31	7	2	2	0	0	0
	1989		42	0	14	22	5	1	0	0	0
	1990		42	0	31	8	3	0	0	0	0
Yonge and Escott[b]	1988	19.1	60	0	44	16	0	0	0	0	0
	1989		60	0	49	11	0	0	0	0	0
	1990		60	0	53	7	0	0	0	0	0
Napanee District											
Hallowell[a]	1988	33.0	30	0	15	14	1	0	0	0	0
	1989		30	0	17	11	2	0	0	0	0
	1990		30	0	17	11	1	0	0	0	0
% total trees (n=132)	1988			0	68.2	28.0	2.3	2.3	0	0	0
	1989			0	60.6	33.3	5.3	0.8	0	0	0
	1990			0	76.5	19.7	3.0	0	0	0	0

[a] trees currently tapped for maple sap

[b] undisturbed woodlot

Table 15. A 7-year summary of data collected from two red oak plots established in Carleton Place District of the Eastern Region of Ontario (based on an examination of 100 trees per location).

Location	Avg. DBH of trees (cm)	Stand size (ha)	Year	Current dieback classes[a] (No. of trees)						Cumulative dieback classes[a] (No. of trees)					
				0	1	2	3	4	New trees dead	0	1	2	3	4	Total trees dead
Carleton Place District															
Lavant Twp - Plot 1	26.3	40.0	1984	10	51	20	6	6	0	0	26	43	15	5	0
			1985	36	35	14	7	1	0	0	26	47	15	5	0
	26.5	-	1986	43	35	11	1	0	3[b]	0	30	42	12	6	3
			1987	56	31	2	0	0	1[b]	3	40	32	11	3	4
			1988	51	36	1	1	0	0	6	56	23	4	0	4
			1989	28	58	1	1	0	1	2	49	26	11	0	5
			1990	4	76	2	0	3	3	0	42	38	2	3	8
Lavant Twp - Plot 2 Flower Station	21.4	15.0	1984	19	48	18	3	2	0	-	19	49	19	3	0
			1985	48	37	3	0	2	0	0	31	47	11	1	0
	21.9	-	1986	42	39	8	0	0	1[b]	0	39	44	4	2	1
			1987	66	20	3	0	0	0	6	51	25	3	4	1
			1988	63	26	0	0	0	0	7	58	22	1	1	1
			1989	27	59	1	0	0	2	1	70	11	5	0	3
			1990	48	34	1	0	2	2	2	75	5	1	2	5

[a] 0 = 0-5%, 1 = 6-20%, 2 = 21-40%, 3 = 41-60%, 4 = >60%

[b] blowdown

SPECIAL SURVEYS

Pear Thrips, *Taeniothrips inconsequens* (Uzel)

Bud and flower samples were obtained from 36 sites (Fig. 8) (10 samples from each of three trees per location) have been submitted for identification of this recent pest[1] of sugar maple, ash, cherry (*Prunus* spp.), beech (*Fagus* spp.) and basswood (*Tilia* spp.) in Eastern Region since 1989. Areas of light damage have been reported from various locations in Ontario, including a small woodlot of sugar maple off Prince Edward County Road 12 north of West Lake, Hallowell Township, Napanee District. This same woodlot also sustained light foliar damage to basswood that has been confirmed to be the result of pear thrips feeding. Monitoring of this and other areas will continue in 1991.

The following areas have been confirmed as hosting pear thrips:

- the Gananoque Wildlife Area, Front of Leeds and Lansdowne Twp, Brockville District
- the junction of Concession IV and Stormont, Dundas and Glengarry County Road 23, Lancaster Township, Cornwall District
- Bridge End, Lancaster Township, Cornwall District
- north of Sandbanks Provincial Park, Hallowell Township, Napanee District
- Wolf Island near Marysville, Napanee District
- Wolf Island, Alexandria Pt., Napanee District
- Highway 7 near Marmora, Marmora Township, Tweed District
- Highway 7 near Madoc, Madoc Twp, Tweed District
- Bannockburn, Madoc Township, Tweed District
- Glastonbury Road, Kaladar Township, Tweed District.

Climatic Data

Temperature and precipitation have obvious effects on the occurrence of abiotic damage (e.g., drought), but also influence insects and diseases. Table 16 contains mean monthly temperatures and total precipitation figures from two locations in Eastern Region.

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[1] Keizer, A. 1990. Results of forest insect and disease surveys in the Eastern Region of Ontario, 1989. For. Can., Ont. Region, Sault Ste. Marie, Ont. Misc. Rep. 93.

Table 16. A comparison of 1990 mean temperatures and total precipitation with their normal values (based on a 30-year period) at two locations in the Eastern Region of Ontario.

Location	Month	Mean temperature (°C)		Deviation from normal (°C)	Total precipitation (mm)		Deviation from normal (mm)
		Normal	Actual		Normal	Actual	
Ottawa International Airport	Jan.	-10.9	-4.6	+6.3	61.0	73.7	+12.7
	Feb.	-9.5	-6.9	+2.6	60.3	84.2	+23.9
	Mar.	-3.0	-1.8	+1.2	67.5	35.3	-32.2
	Apr.	5.6	7.3	+1.7	69.1	83.3	+14.2
	May	12.8	11.6	-1.2	67.9	54.0	-13.9
	June	18.0	18.6	+0.6	73.4	38.0	-35.4
	July	20.6	21.4	+0.8	85.9	114.3	+28.4
	Aug.	19.2	20.3	+1.1	88.4	135.0	+46.6
	Sept.	14.3	13.4	-0.9	79.3	103.0	+23.7
	Oct.	8.1	7.9	-0.2	68.1	95.9	+27.8
	Nov.	1.2	2.3	+1.1	77.7	70.2	-7.5
	Dec.	-7.7	-5.5	+2.2	80.7	121.5	+40.8
Trenton Air Base	Jan.	-7.6	-1.8	+5.8	68.9	59.2	-9.7
	Feb.	-6.5	-4.9	+1.6	57.0	73.7	+16.7
	Mar.	-1.0	-0.1	+0.9	72.0	53.2	-18.8
	Apr.	6.4	7.3	+0.9	76.1	80.1	+4.0
	May	12.5	11.0	-1.5	73.0	117.6	+44.6
	June	17.8	17.7	-0.1	63.7	87.0	+23.3
	July	20.6	20.3	-0.3	60.9	68.6	+7.7
	Aug.	19.7	20.0	+0.3	71.9	78.2	+6.3
	Sept.	15.3	14.2	-1.1	72.8	39.2	-33.6
	Oct.	9.2	8.5	-0.7	70.1	96.7	+26.6
	Nov.	3.2	3.6	+0.4	86.1	49.6	-36.5
	Dec.	-4.5	-1.9	+2.6	82.9	145.8	+62.9

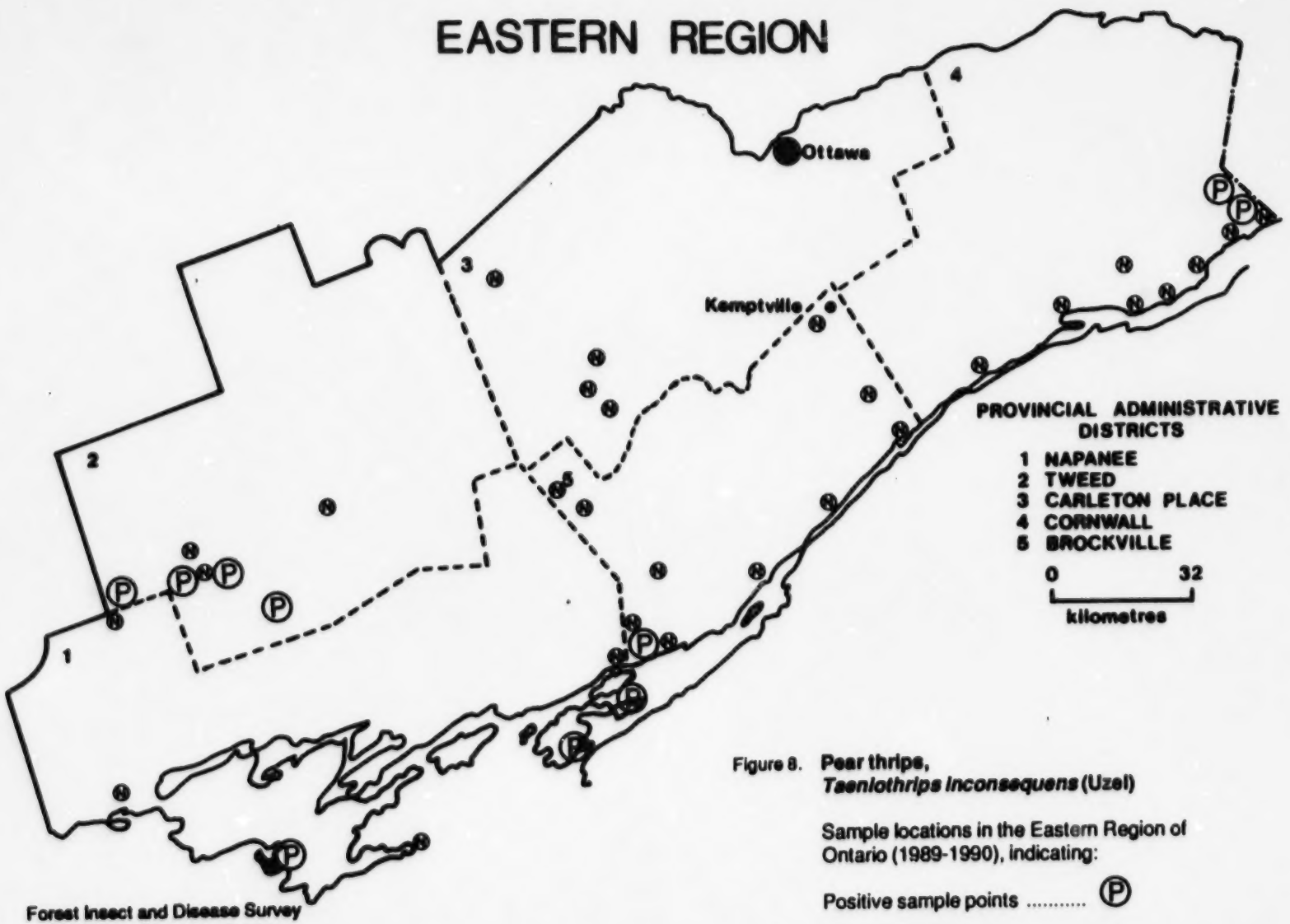

Figure 8. **Pear thrips, *Taeniothrips inconsequens* (Uzel)**

Sample locations in the Eastern Region of Ontario (1989-1990), indicating:

Positive sample points ..... Ⓟ

Negative sample points ..... Ⓝ